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NEAR FIELD ACCELEROMETER ARRAY

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California University

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This is the final report for Grant AFOSR-72-2392 and it outlines the accomplishments during the two and one half years of its tenure. A portable near-field accelerometer array consisting of 9 stations was developed and installed in the Stone Canyon-Bear Valley region of central California. A detailed study was made of the seismicity in this region. Fault plane solutions of over 150 earthquakes were studied. Three earthquakes were studied in detail and some interesting patterns in P and S corner frequencies in the near field were revealed.

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I Report Summary

This is the final report for Grant AFOSR-72-2392 and it outlines the accomplishments during the two and one half years of its tenure.

A portable near-field accelerometer array consisting of 9 stations was developed and installed in the Stone Canyon-Bear Valley region of central California. The array is capable of recording ground motion up to 0.3 g in the frequency range 0.03 to 50 Hz. The 54 data channels of the array are recorded in a convenient form with a common time base on analog magnetic tape at a central site. The maximum dimensions of the array are about 10 km.

A detailed study of the seismicity in the Stone Canyon-Bear Valley region revealed short periods of intense clustered activity separated by much longer periods of more subdued and diffuse activity. Fault plane solutions of over 150 earthquakes were studied and revealed some interesting features of the tectonics and velocity structure of the crust.

A study of attenuation of shear waves yielded low values of Q for the upper crust and differences between the crust on the two sides of the fault. It was found that for earthquakes of magnitude 3 the corner frequencies were large enough so that an accurate knowledge of attenuation in the crust was required in the interpretation. Detailed studies were made of three events recorded by the near-field array and revealed some interesting patterns in the differences between P and S corner frequencies and the azimuthal distribution of corner frequencies. A digital tape containing the near-field data from these three events has been prepared and is available to other investigators. However, since installation of the near-field array, the type of earthquake for which the experiment was designed has not occurred and in this sense the experiment is still incomplete.

Methods of calculating exact solutions for the displacement and tilt resulting from a dislocation source in a halfspace were developed and applied to the interpretation of various types of data.

Thirteen papers were prepared covering the research conducted under this grant.

II Introduction

The near-field project grew out of some of the problems that became apparent at the Woods Hole meeting on seismic discrimination in 1970. At that time it became clear that the type of high-quality data necessary to test and differentiate between various theoretical models of an earthquake source were not available. Recognition of this problem led an ad hoc panel, chaired by Stewart Smith, to issue a report entitled "The near-field long-period spectrum of earthquakes and the discrimination problem" in January of 1971. This report proposed a concentrated group effort directed at obtaining a large amount of high-quality data from only a few earthquakes, as opposed to the standard practice of obtaining mostly by chance a few high-quality data from each of a large number of earthquakes. The report suggested the idea of 'trapping an earthquake' in the magnitude range between 3.0 and 5.0 in the center of a comprehensive experiment designed to record data spanning a large range in frequency, azimuth, and distance. Further discussion among interested parties led to the suggestion that the Stone Canyon-Bear Valley region of the San Andreas fault zone in central California would be a reasonable place to try such an experiment. This region offered the advantages of a high rate of earthquake activity, a relatively simple tectonic pattern, ample historical data on the seismicity of the region, good control on earthquake locations, and easy accessibility.

Funding of such a near-field project by the AFOSR began in 1972. As its part in the cooperative program, U.C. Berkeley had the responsibility of developing and installing an array of three-component strong-motion continuous-recording broad-band accelerometers in a tight network in the immediate vicinity of the anticipated earthquake. The purpose of this array was to provide broadband data recorded within a few km of an earthquake source.

Funding for the near-field accelerometer array under grant AFOSR-72-2392 began in June of 1972 and continued for two and one half years. This final report summarizes the accomplishments during this period of time. More detailed discussions can be found in the 10 Quarterly Management Reports and the 4 Technical Reports that have been submitted and in the papers listed in part IX of this report.

III Development of the Near-Field Array

One aspect of this research project was to develop a portable near-field array capable of recovering ground motion in the frequency bandwidth 0.02 to 50 Hz recorded at a distance range of 0 to 50 km from either an earthquake or an explosion. The array which was developed contains nine stations, a number which we thought was necessary to give the azimuthal and distance coverage which are required in near-field studies of this type.

The sensors employed in the array are force-balance accelerometers which are designed to withstand up to 2 g of acceleration. This means that the usual worries about linearity of response that are present when a conventional seismometer with moving parts is subjected to strong ground motion have been avoided. Another advantage of these sensors is that they are small and easy to install. The three components that comprise a station are all mounted within a single water-tight 8 inch cube and installation simply consists of burying this cube at a depth of 2 to 3 feet.

When this research effort began, it was not certain that long-period ground motion could be reliably recovered from conventional force-balance accelerometers with a resonant frequency of 200 Hz such as those used in the near-field array. However, the circuit which was designed to doubly integrate the accelerometer output to give an output proportional to ground displacement has been a success. The response functions of both the acceleration output and the displacement output are shown in Figure 1. The displacement outputs roll off on the low frequency end with a corner at 30 sec. Originally this corner was placed at 120 sec but it was found that the ground tilts which can be quite large at distances of a few km from an earthquake were dominating the displacement outputs and limiting their gain. Thus, as a compromise between recording displacements and tilts in the low frequency range, we have been using a corner frequency of 30 sec which allows a high enough gain setting to recover displacement data in the range 30 to 1 sec and still provides some information on the tilts at 30 sec and slightly longer periods.

To insure portability, data from the near-field array are transmitted to a central recording site via radio telemetry. Radio frequencies in the 72-76 MHz band are used, which gives line-of-sight transmission. The receiving antennas are located on a hilltop near the central recording site. Both the seismometer package and the radio are light weight and low power. Originally, the remote stations of the array were powered with 6-volt automobile batteries, but now air cell batteries are used which means that stations will operate unattended for periods of over a year at a time. About the only problem encountered at the remote stations has been due to animals, but use of rodent-proof cables and fence posts to keep cattle off the antennas has effectively solved these minor problems. The four array stations which were closest to the fault were easily connected to the central recording site with direct land wires through the use of existing phone lines and short lengths of cables which were laid for this purpose. Because of troubles with cables being cut and phone lines being down, these directly coupled stations of the array have actually had more down time than those that are radio coupled.

All of the data are transmitted and recorded in an FM format. All of the VCOs and discriminators employed in this project were fabricated in our laboratory using a rather inexpensive design that relies on an

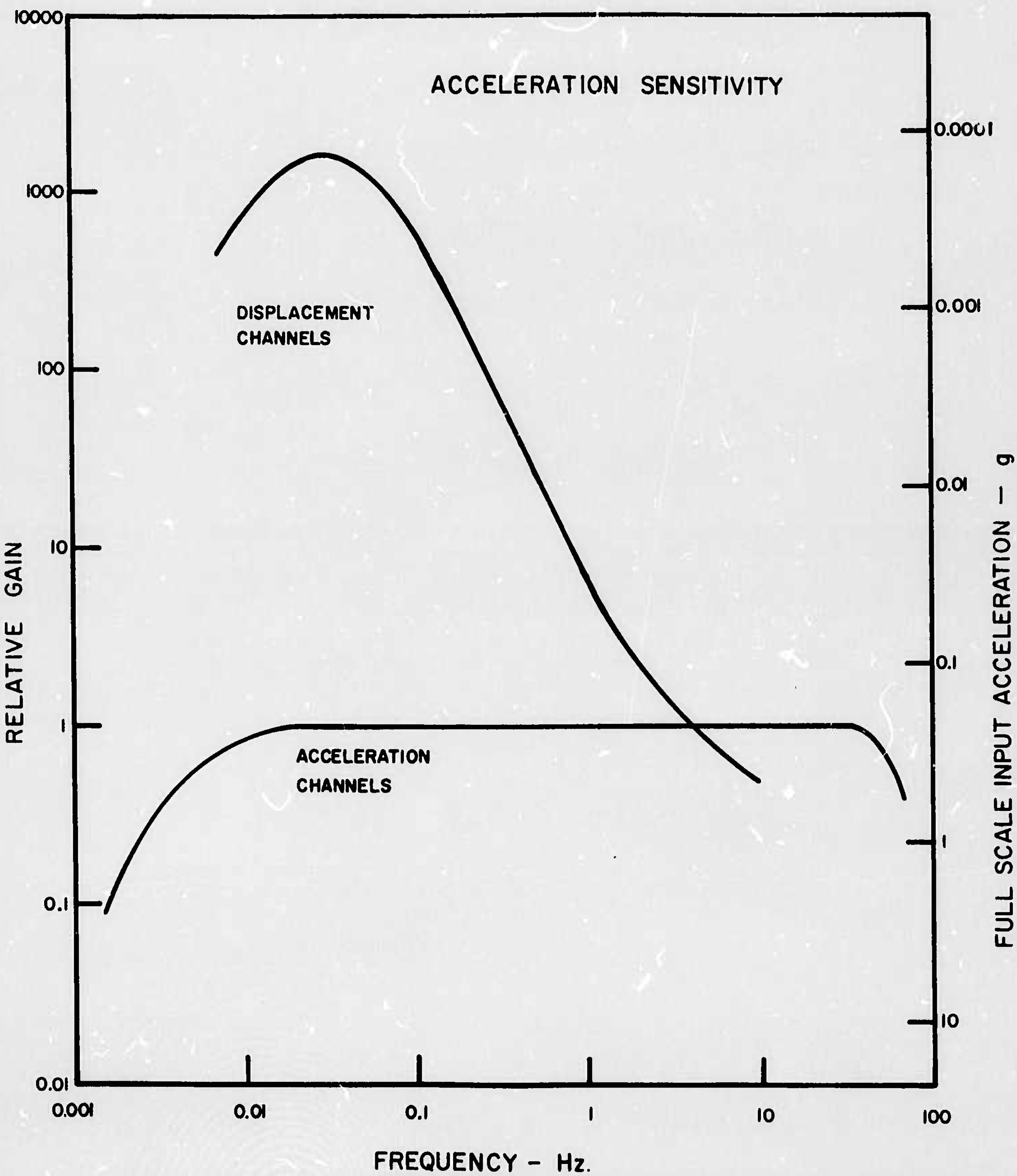

Figure 1. The system response functions of the acceleration and displacement channels.

integrated-circuit phase-lock-loop. Equipment with this same type of design has since become commercially available.

An important property of this research effort is the fact that the data are continuously recorded with a common time base. This insures that the beginning of the P phases can be recorded and analyzed, something which is usually not possible with conventional triggered strong motion instrumentation. With six data channels, acceleration and displacement outputs from each of three orthogonal directions of ground motion, coming from each of the nine stations of the array, a total of 54 channels of data have to be recorded in a continuous mode with a bandwidth of 50 Hz. In addition, 12 channels of output from creepmeters operated by the Earthquake Mechanism Laboratory of NOAA were recorded, and since 07 February 1974, 6 channels of data from short-period stations operated by the USGS in the Stone Canyon-Bear Valley region have been recorded. To record all of these data has required the operation of 5 analog tape recorders. Three of these are the old LRSM Ampex units running at a speed of 0.3 inch/sec (tape changed once per day) and two are Geotech Model 19429 tape recorders running at a speed of 0.12 inch/sec (tape changed every 7 days). The details of this data recording scheme are given in Table 1.

Maintaining the five tape recorders in satisfactory operating condition with reasonably low noise levels has presented the main operational difficulty of the project. The advanced age of some of the tape recorders and the difficulty in obtaining spare parts has been part of the problem. Our plans (and a recommendation for future projects of this type) are to replace these five tape decks recording in an FM mode with a single tape deck recording in a direct analog mode. By recording FM tone bundles containing up to 8 data channels on each of the 14 tracks on the tape, a total of 112 data channels can be recorded on a tape deck that has to be changed once a day.

Aside from routine quality checks on the recording system, all of our data analysis has been performed on digitized data. The analog tapes are converted to digital data at our Berkeley laboratory using an automatic analog-to-digital converter. With suitable anti-aliasing filters at 50 Hz, a sample of rate of 125 samples per sec has usually been sufficient, although on occasions we have used rates of 250 samples per sec. Analysis of these digital data has been performed on a CDC 6400 computer up to the present time. Shortly we shall begin doing this analysis on a seismic analysis system which contains a graphic display which will allow for a much more interactive mode of analysis. With the large number of data channels involved in this project, such interactive analysis should be quite useful. All of the digitized data which have been deemed suitable for analysis have been made available to other investigators and are described in a later section of this report.

Installation of the stations of the near-field array began in the autumn of 1972. Because of heavy rains that winter (the river flooded and a couple of bridges washed out) it took until March to install the first six stations, and the remaining three stations were put in shortly thereafter. The stations were located with an emphasis on azimuths north and east of the Stone Canyon-Bear Valley region, the same azimuths occupied by the more distant long-period stations of the University of Washington and the University of Nevada. Figure 2 and Table 1 give the locations of the array stations from that time until May of 1974. When two of the stations (numbers 5 and 6) had to be moved in May of 1974, it was decided to place another station in the granitic Gabilan block on the west side of the San Andreas fault. Figure 3 and Table 2 give the locations of the array stations from 03 May 1974 until the present.

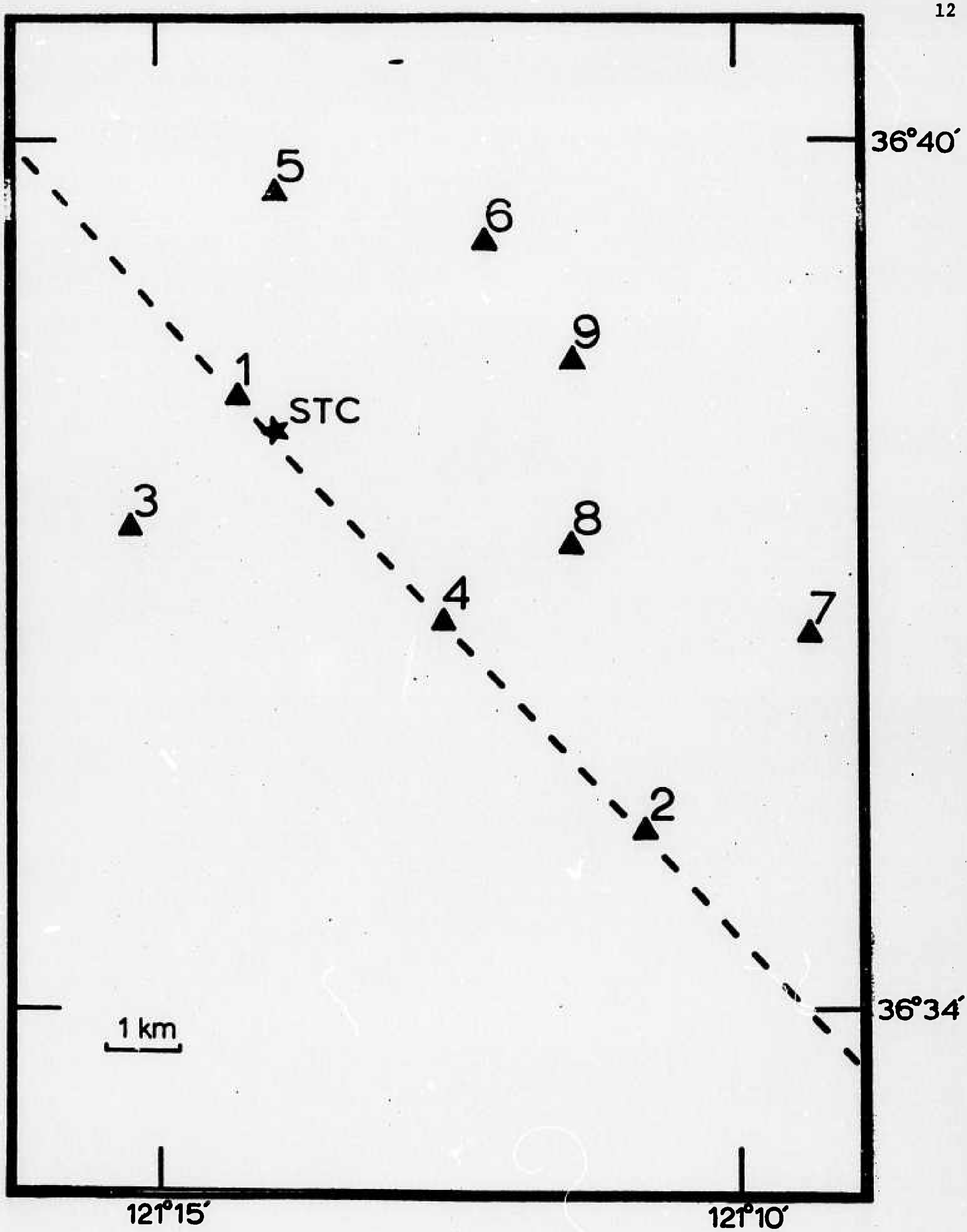

Figure 2. Locations of the near-field array stations prior to May 1974.

Table I. Station locations and recording system details, August 1973.

Station	Location	Latitude d m s	Longitude d m s	Elev.(ft)	Radio Freq. (M Hz)	Tape Unit	Tape Channels
1	Stone Canyon-N	36 38 15	121 14 15	810	-	UC4	9-14
2	Melendy-Windmill	36 35 04	121 10 38	1035	-	UC2	9-14
3	101 Ranch-Hilltop	36 37 25	121 15 07	2435	-	UC4	2-8
4	Hawkins-Jungle Inn	36 36 48	121 12 32	1000	-	UC2	2-8
5	Libby-N	36 39 40	121 13 56	1380	72.240	UC3	2-8
6	Libby-Deadend	36 39 18	121 12 08	2100	72.320	UC3	9-14
7	Melendy-Ridge	36 36 44	121 09 29	2620	72.760	UC1	9-14
8	Melendy-Cross	36 37 16	121 11 24	2542	72.040	UC1	2-8
9	Nielsen	36 38 33	121 11 27	2180	72.880	UC5	9-14

UC5 Channels 2-8 are USGS stations BEN(5), BVL(8)

Channel Assignments		Center Freq.(Hz)	Comp.	Sense of Ground Motion for Positive Discriminator Output Voltage
2	9	1020	z accel.	down
3	10	1360	R "	N45E
4	11	1700	T "	S45E
5	12	2040	z Disp.	down
6	13	2360	R Displ.	N45E
8	14	2720	T "	S45E

1 Vela 10 Hz Time Code

7 Compensation

	(UC1, 2, 3)	(UC 4,5)
Tape Speed	0.3 ips	0.12 ips
Cent. Freq.	270 Hz	216 Hz
Bandwidth	0-50 Hz	0-40 Hz

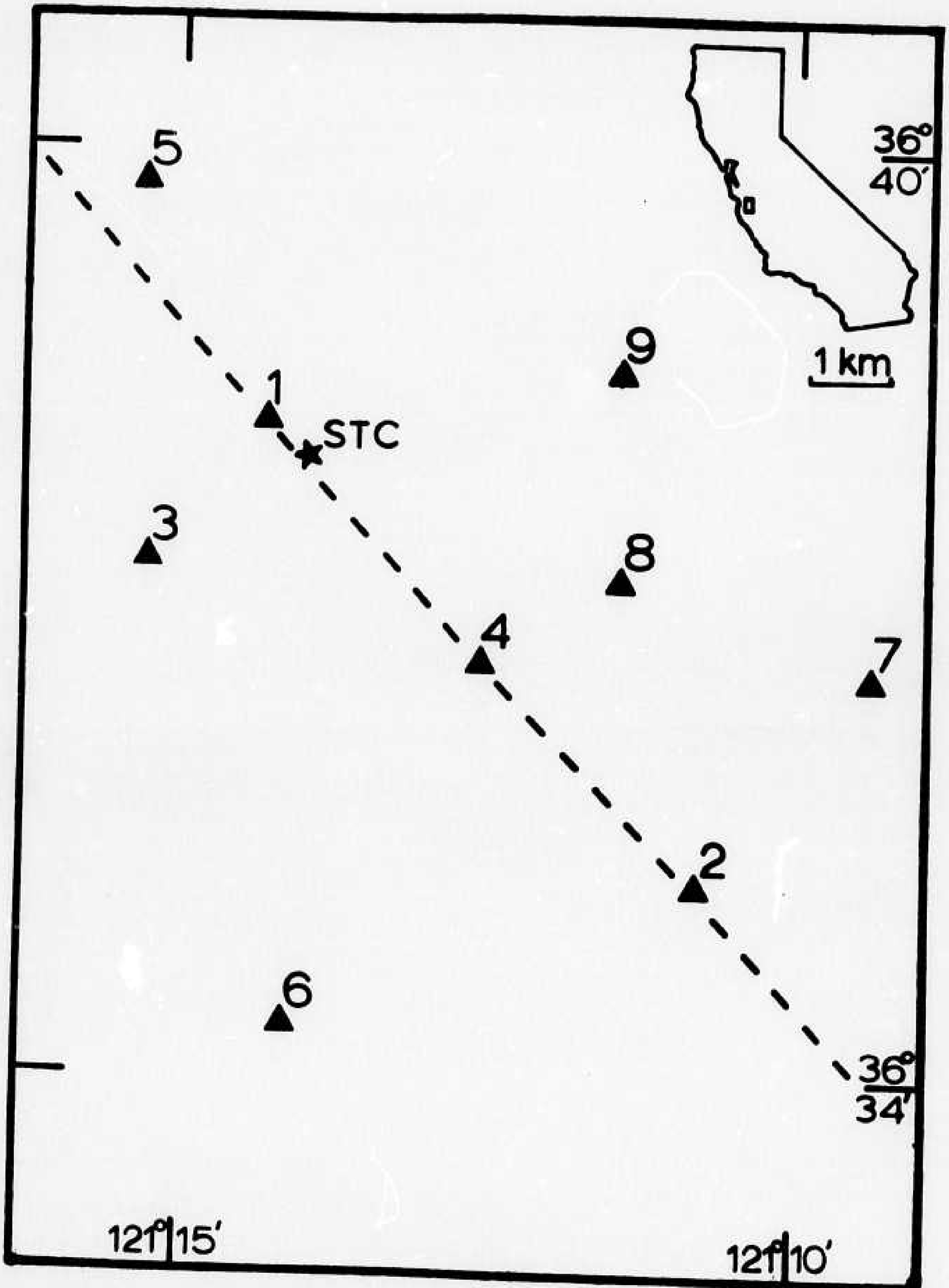

Figure 3. Locations of the near-field array stations after May 1974.

Table 2. Station locations and recording system details, May, 1974.

Station	Location	Latitude d m s	Longitude d m s	Elev.(ft)	Radio Freq. (M Hz)	Tape Unit	Tape Channels
1	Stone Canyon-N	36 38 15	121 14 15	810	-	UC4	9-14
2	Melendy-Windmill	36 35 04	121 10 38	1035	-	UC4	2-8*
3	101 Ranch-Hilltop	36 37 25	121 15 07	2435	-	UC2	9-14*
4	Hawkins-Jungle Inn	36 36 48	121 12 32	1000	-	UC2	2-8
5	Hills Hill	36 39 45	121 15 16	975	72.240	UC3	2-8
6	Bickmore	36 34 17	121 14 05	2280	72.320	UC3	9-14
7	Melendy-Ridge	36 36 44	121 09 29	2620	72.760	UC5	2-8*
8	Melendy-Cross	36 37 16	121 11 24	2542	72.040	UC1	2-8
9	Nielsen	36 38 33	121 11 27	2180	72.880	UC5	9-14

* from 02Nov73

UC1 Channels 9-14: USGS stations BEN-Z(9), STC-Z(10), BVL-N(11), STC-R(12), STC-T(13), BVL-Z(14), since 07Feb74.

Channel Assignments		Center Freq.(Hz)	Comp.	Sense of Ground Motion for Positive Discriminator Output Voltage
2	9	1020	Z accel.	down
3	10	1360	R "	N45E
4	11	1700	T "	S45E
5	12	2040	Z Disp.	down
6	13	2380	R Displ.	N45E
8	14	2720	T "	S45E

1 Vela 10 Hz Time Code

7 Compensation

Tape Speed	0.3 ips (UC1, 2, 3)	0.12 ips (UC 4,5)
Cent. Freq.	270 Hz	216 Hz
Bandwidth	0-50 Hz	0-40 Hz

IV Studies of Seismicity

In order to keep all participants in the near-field project informed of seismic activity in the Stone Canyon-Bear Valley region, a weekly information bulletin was assembled and sent to all interested parties. This bulletin contained a list of earthquakes in the general Stone Canyon-Bear Valley region, a summary of creepmeter activity in the region, a list of events and time periods that had been retained for further study in the Berkeley tape library, and "final" hypocenter parameters of the events for which detailed studies had been made. This information bulletin was prepared by Karen McNally, and 72 issues were distributed in the period between 01 January 1973 and 24 Nov 1974.

With the intention of obtaining a more accurate picture of seismicity patterns in the Stone Canyon-Bear Valley region, a study was made of all recorded earthquakes in this region since 1961. A method employing fixed groups of stations and station corrections was developed and used to obtain a homogeneous set of locations for all earthquakes in this region since 1961 with magnitudes greater or equal to 2.5. In the period since 01 September 1971 the magnitude threshold was reduced to 2.0. These hypocentral data are tabulated and plotted in Technical Report No. 2 (16 August 1973), Technical Report No. 3 (16 March 1974), and Technical Report No. 4 (10 November 1974). This study revealed that the "normal" seismicity along the San Andreas fault in the Stone Canyon-Bear Valley region consists of a rather uniform and diffuse distribution of epicenters in both space and time. However, this pattern is occasionally interrupted by short periods of time in which the seismic activity becomes more intense and there is major clustering of earthquakes in both space and time. Two such periods of intense activity have been identified, one in 1960-1961 and another starting in late 1971 and extending into the first half of 1973. Rather diabolically, the ending of this last period of intense activity coincided with the installation of instruments for the near-field project.

Another interesting facet of earthquakes in the Stone Canyon-Bear Valley region was uncovered through the study of fault plane solutions. Fault plane solutions were constructed for over 150 earthquakes and they revealed an almost total predominance of strike-slip motion on near-vertical fault planes. When these fault plane solutions are plotted on a map the earthquakes east of the San Andreas fault zone show a tendency to bifurcate along directions parallel to the Calaveras fault which separates from the main trace of the San Andreas fault further to the north. (See Technical Report No. 4, 10 November 1974). The detailed study of fault plane solutions also revealed that apparent inconsistencies in the polarity of motion on the focal sphere were due to anomalous ray paths for waves travelling along the fault zone. This result has been interpreted to mean that the velocity-depth profiles are quite different on the two sides of the fault in this part of central California. The results of these various studies have been presented in papers by McNally (1974), Savage and McNally (1974), and McNally and McEvilly (1974).

A short study was also conducted of the seismic and related tectonic patterns in the Cape Mendocino area, the most active seismic region in California. Results of this study were presented in a paper by Peppin _et al_. (1974) and will soon be published by Simila _et al_. (1975).

V Studies of Crustal Structure

The interpretation of near-field data requires that the material properties of the crust be known so that corrections can be made for wave propagation effects. Knowledge of the attenuation properties of the crust are particularly important when it comes to interpreting the corner frequencies of P and S waves. The dimensions of the near-field array were made small in order to mitigate some of the effects of attenuation, but for small events with corner frequencies of several Hz, corrections for attenuation are still required.

Accurate measurements of attenuation in the crust are difficult to obtain, particularly in the case of shear waves. In a study by Kurita (1975) a spectral ratio method was developed and used to estimate the attenuation of shear waves in the Stone Canyon-Bear Valley region. A difference was found on the two sides of the San Andreas fault zone with a value as low as 20 for the Q of shear waves in the upper part of the crust northeast of the fault and a value of about 100 southwest of the fault.

VI Studies of Source Properties

A primary objective of the near-field project has been to increase our understanding of the basic physical processes that occur at an earthquake source, or to at least obtain an empirical description of the source which would allow one to predict systematically the properties of the elastic waves which are radiated from it. The emphasis in our part of the project has been to obtain data very near to the source with the expectation of seeing the effect of the finite size of the source. By observing a single source at several different azimuths we also hoped to observe the effects of source propagation or any other asymmetries in the radiation pattern. Such studies require that elastic waves having wavelengths comparable to the dimensions of the source be used, and for events in the magnitude range of 3 to 5 this implies that frequencies equal to or greater than 1 Hz be recorded. The bandwidth of the near-field array extends to 50 Hz to provide this capability. At the same time it is desirable to record the long period motions near the source both because they also contain information about the source and because it is at these longer wavelengths that one can make a direct comparison between data obtained from the near-field array and the data obtained by the other participants in the near-field project at more distant locations. Because of these reasons, the near-field array was designed as a broad-band system with an effective flat response between 30 sec and 50 Hz.

While waiting for the near-field array to be installed and data to accumulate, analysis was begun on a set of data that had been already recorded at the San Andreas Geophysical Observatory (SAGO) a few km north of the Stone Canyon-Bear Valley region. While the bandwidth of these data was not so large (30 sec to 10 Hz) nor the azimuthal coverage so complete (only 2 stations) as that of the near-field array, they did provide an opportunity to develop analysis procedures that could later be applied to the near-field data and they also provided some interesting results concerning source parameters of earthquakes in this part of central California.

The results of this study of the SAGO data have been published (Johnson and McEvilly, 1974) so the main conclusions will only be summarized here. For the 13 earthquakes which were studied it was found that the seismic moments estimated from the low frequency levels of the spectra showed a linear dependence on magnitude that was generally consistent with what other investigators have been finding in similar studies. An interesting observation was that the moments estimated on the two sides of the fault zone differed by a factor of 3. Somewhat surprising was the result that the corner frequency of the spectra showed only a very weak dependence upon magnitude. This result raised the possibility that the corner frequency was not controlled by the source dimension but rather by some other source parameter such as rise time of the source function. The results and the unanswered questions of this study all seemed to reinforce the objectives, methods, and importance of the near-field project.

Because it was clear from the outset that the earthquakes to be recorded in the Stone Canyon-Bear Valley region by the near-field project would most likely be moderate in magnitude and almost certainly be strike-slip in type, it was considered desirable to gain some experience with other types of earthquakes. The San Fernando earthquake of 1971, having a magnitude of 6.5 and a thurst type of fault motion, provided such an opportunity. A study was undertaken to explain some of the near-field observations of that earthquake, in particular the strong-motion accelerograph records obtained at the Pacoima Dam site. A theoretical model was developed for a propagating line dislocation source in a halfspace which has proved to be quite successful in the difficult task of explaining the observed acceleration records. Two progress reports (Litehiser, 1972; Litehiser, 1974) were presented on this work, and the sum of all the work will be included in a thesis by Joe Litehiser which is in the final stages of preparation. In the course of this study, several associated problems such as the response function of a strong-motion accelerograph and the mathematical form of the source time function were also considered.

Since installation of the near-field array, three events have occurred in the Stone Canyon-Bear Valley region which produced useable data. The event on 22 June 1973 was in the magnitude range (M_L=4.2) for which the experiment was designed but, most likely because of the greater than average depth of this event, the observed amplitudes were not as large as expected. The maximum acceleration was 6% g. A corner frequency of 2 to 3 Hz was estimated from whole-record spectra. The estimated moment was rather uncertain, but not inconsistent with other studies of earthquakes of this magnitude. This earthquake provided the first realistic test of the near-field array and served as an effective shake-down experiment. Troubles with noise levels in the tape recorders were identified and it was decided to move the low frequency corner of the displacement outputs from 120 to 30 sec on the basis of tilts seen near this earthquake.

On 07 February 1974 an earthquake occurred near the southern end of the near-field array which yielded some useful data. The magnitude was small (M_L=3.0) and the maximum acceleration was 6% g at the closest station. The slightly larger earthquake on 06 July 1974 (M_L=3.3) provided similar but better quality data, so our analysis has been concentrated on this latter event. The earthquake in July was a couple of km south of the near-field array and gave useable data at 6 of the array stations, but the amplitudes at the 3 most northerly stations were too small to be analyzed with confidence. The maximum acceleration was about 20% g at the closest station, a surprisingly large value for an earthquake of this magnitude. The spectra of both P and S waves were analyzed for this earthquake. The corner frequencies estimated from the P spectra ranged up to 15 Hz, with the P corner frequency always greater than the S corner frequency, although this difference in corner frequencies of P and S waves can possibly be explained by the effects of attenuation upon the propagating waves. Although this earthquake was not within the array, about 100° of azimuthal coverage was obtained and this revealed an interesting pattern, with higher corner frequencies along the fault zone falling off to lower values away from the fault zone on either side. Technical Report Number 4 of 10 November 1974 contains a complete description of the data and results obtained from this earthquake. The study of this earthquake has raised some interesting questions which could best be resolved by recording another such earthquake, this one with the epicenter within the near-field array so that a more complete azimuthal coverage can be obtained.

VII Theoretical studies of seismic sources

In order to extract information about the source from a seismogram observed some distance away, one must first understand and remove the effects of wave propagation between source and receiver. At locations relatively near to the source these effects of wave propagation can actually be more complicated than at more distant points because of the so-called 'near-field' terms in the solution to the elastodynamic equations.

A set of computer programs have been developed for handling this problem of wave propagation. The programs compute exact solutions for an arbitrarily oriented dislocation source in a homogeneous halfspace. The method of solution is given in Johnson (1974). These programs were used to interpret broadband data recorded at the San Andreas Geophysical Observatory (Johnson and McEvilly, 1974), and they have also been used in the analysis of the data acquired by the near-field array.

Another problem encountered when recording ground motion near to a seismic source is connected with the tilt of the ground. It is often difficult to know if the low-frequency output of a broadband seismometer is due to ground displacement or ground tilt, and this can cause considerable problems in the interpretation of the low-frequency portion of the spectrum. Theoretical calculations of both displacement and tilt can serve as a useful guideline in this problem because they give an estimate of the relative magnitudes and time histories to be expected from these two different phenomena. The paper by Johnson and McEvilly (1974) and Technical Report No. 4 (10 November 1974) illustrate applications of this type.

VIII Available Data

The data from all earthquakes in the Stone Canyon-Bear Valley region with magnitudes greater than 2.5 that have occurred since installation of the near-field array have been retained in a tape library at Berkeley. These events are listed in Table 3. Three of these earthquakes, those occurring on 22 June 1973, 07 February 1974, and 06 July 1974 were recorded with sufficient amplitudes by the near-field array to warrant detailed analysis. The data from these three earthquakes have been placed in convenient digital form on a magnetic tape in order to make them available to other investigators. The tape is written in a card image BCD format on a standard 7-track digital tape. Table 4 is a listing of the data files contained on this tape. The first file on the tape is a computer program that will read and unpack the data files. A listing of this program is included as Table 5.

Table 3. Earthquakes retained in the near-field library. Asterisks denote events that have been digitized.

Date		Origin Time	Latitude	Longitude	Depth	Magnitude
1-15-73	0943	094329.95	3641.1	12119.5	4.64	4.1
1-15-73	1008	100832.91	3641.2	12120.1	6.21	3.0
1-15-73	1013	101338.94	3641.3	12120.0	5.61	2.9
1-15-73	1023	102343.41	3640.8	12119.2	5.15	3.[illegible]
1-15-73	1441	144122.37	3641.0	12119.4	5.37	3.7
1-15-73	1519	151925.94	3641.6	12120.2	6.77	2.6
1-15-73	1530	153008.61	3640.6	12118.6	7.31	3.0
1-15-73	1922	192231.62	3640.6	12118.9	5.34	2.6
1-15-73	2013	201346.76	3640.6	12118.6	4.92	3.0
1-15-73	2017	201704.60	3640.4	12118.4	4.71	2.8
1-15-73	2114	211450.85	3640.4	12118.4	5.44	3.2
6-22-73 *	0129	012912.25	3635.4	12111.6	9.45	4.2
8-02-73	1610	161042.36	3634.2	12109.8	8.54	3.3
2-07-74 *	1035	103505.93	3635.3	12111.8	5.28	3.0
3-08-74	1855	185515.01	3639.1	12116.9	3.20	2.5
3-08-74	1856	185619.08	3639.1	12116.7	3.22	2.6
3-08-74	1910	191014.89	3639.2	12116.9	4.20	3.0
7-06-74 *	0403	040356.03	3634.1	12110.1	6.57	3.3
8-04-74	1503	150345.48	3637.4	12114.2	6.92	3.1
8-04-74	1733	173324.44	3637.6	12114.5	7.57	2.9
9-07-74	2045	204556.10	3635.1	12111.4	8.38	3.1
9-12-74	2121	212119.99	3638.0	12115.1	6.21	3.0

Table 4. Data files contained on the near-field digital tape.

```
 1   22 JUN 73, 0129, STONE CANYON NORTH (1), R ACC
        1   0   0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.06667 0 0.02000 0  100.00
     2  .02500 (1) R ACC      2500      NOISE

 2   22 JUN 73, 0129, STONE CANYON NORTH (1), R ACC
        1   0   0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.06667 0 0.02000 0  100.00
     2  .02500 (1) R ACC      2500      SIGNAL

 3   22 JUN 73, 0129, STONE CANYON NORTH (1), T ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.06667 0 0.02000 0  100.00
     2  .02500 (1) T ACC      2500      NOISE

 4   22 JUN 73, 0129, STONE CANYON NORTH (1), T ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.06667 0 0.02000 0  100.00
     2  .02500 (1) T ACC      2500      SIGNAL

 5   22 JUN 73, 0129, STONE CANYON NORTH (1), Z ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.06667 0 0.02000 0  100.00
     2  .02500 (1) Z ACC      2500      NOISE

 6   22 JUN 73, 0129, STONE CANYON NORTH (1), Z ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.06667 0 0.02000 0  100.00
     2  .02500 (1) Z ACC      2500      SIGNAL

 7   22 JUN 73, 0129, MELENDY WINDMILL (2), R ACC
        1   0   0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000-4  100.00
     2  .00400 (2) R ACC      2500      NOISE

 8   22 JUN 73, 0129, MELENDY WINDMILL (2), R ACC
        1   0   0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000-4  100.00
     2  .00400 (2) R ACC      2500      SIGNAL

 9   22 JUN 73, 0129, MELENDY WINDMILL (2), T ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000-4  100.00
     2  .00400 (2) T ACC      2500      NOISE

10   22 JUN 73, 0129, MELENDY WINDMILL (2), T ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000-4  100.00
     2  .00400 (2) T ACC      2500      SIGNAL

11   22 JUN 73, 0129, MELENDY WINDMILL (2), Z ACC
        1   0  -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000-4  100.00
     2  .00400 (2) Z ACC      2500      NOISE
```

```
12    22 JUN 73, 0129, MELENDY WINDMILL (2), Z ACC
         1     0   -0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02000 4 0.02000-4  100.00
      2  .00400 (2) Z ACC         2500      SIGNAL

13    22 JUN 73, 0129, HILLTOP (3), R ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.06667 0 0.02000 0  100.00
      2  .02500 (3) R ACC         2500      NOISE

14    22 JUN 73, 0129, HILLTOP (3), R ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.06667 0 0.02000 0  100.00
      2  .02500 (3) R ACC         2500      SIGNAL

15    22 JUN 73, 0129, HILLTOP (3), T ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.06667 0 0.02000 0  100.00
      2  .02500 (3) T ACC         2500      NOISE

16    22 JUN 73, 0129, HILLTOP (3), T ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.06667 0 0.02000 0  100.00
      2  .02500 (3) T ACC         2500      SIGNAL

17    22 JUN 73, 0129, HILLTOP (3), Z ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.06667 0 0.02000 0  100.00
      2  .02500 (3) Z ACC         2500      NOISE

18    22 JUN 73, 0129, HILLTOP (3), Z ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.06667 0 0.02000 0  100.00
      2  .02500 (3) Z ACC         2500      SIGNAL

19    22 JUN 73, 0129, JUNGLE INN (4), R ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02000 4 0.02000 4  100.00
      2  .00400 (4) R ACC         2500      NOISE

20    22 JUN 73, 0129, JUNGLE INN (4), R ACC
         1     0    0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02000 4 0.02000 4  100.00
      2  .00400 (4) R ACC         2500      SIGNAL

21    22 JUN 73, 0129, JUNGLE INN (4), T ACC
         1     0   -0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02000 4 0.02000 4  100.00
      2  .00400 (4) T ACC         2500      NOISE

22    22 JUN 73, 0129, JUNGLE INN (4), T ACC
         1     0   -0.03716      0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02000 4 0.02000 4  100.00
      2  .00400 (4) T ACC         2500      SIGNAL
```

```
23     22 JUN 73, 0129, JUNGLE INN (4), Z ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 4   100.00
       2   .00400 (4) Z ACC       2500       NOISE

24     22 JUN 73, 0129, JUNGLE INN (4), Z ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 4   100.00
       2   .00400 (4) Z ACC       2500      SIGNAL

25     22 JUN 73, 0129, NNW (5), R ACC
          1    0    0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (5) R ACC       5000       NOISE

26     22 JUN 73, 0129, NNW (5), R ACC
          1    0    0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (5) R ACC       5000      SIGNAL

27     22 JUN 73, 0129, NNW (5), T ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (5) T ACC       5000       NOISE

28     22 JUN 73, 0129, NNW (5), T ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (5) T ACC       5000      SIGNAL

29     22 JUN 73, 0129, NNW (5), Z ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (5) Z ACC       5000       NOISE

30     22 JUN 73, 0129, NNW (5), Z ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (5) Z ACC       5000      SIGNAL

31     22 JUN 73, 0129, DEADEND (6), R ACC
          1    0    0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (6) R ACC       5000       NOISE

32     22 JUN 73, 0129, DEADEND (6), R ACC
          1    0    0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (6) R ACC       5000      SIGNAL

33     22 JUN 73, 0129, DEADEND (6), T ACC
          1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
       4 0.02000 4 0.02000 0   100.00
       2   .00400 (6) T ACC       5000       NOISE
```

```
34   22 JUN 73, 0129, DEADEND (6), T ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 0  100.00
     2  .00400 (6) T ACC         5000      SIGNAL

35   22 JUN 73, 0129, DEADEND (6), Z ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 0  100.00
     2  .00400 (6) Z ACC         5000      NOISE

36   22 JUN 73, 0129, DEADEND (6), Z ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 0  100.00
     2  .00400 (6) Z ACC         5000      SIGNAL

37   22 JUN 73, 0129, MELENDY RIDGE (7), R ACC
        1    0   0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (7) R ACC         2500      NOISE

38   22 JUN 73, 0129, MELENDY RIDGE (7), R ACC
        1    0   0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (7) R ACC         2500      SIGNAL

39   22 JUN 73, 0129, MELENDY RIDGE (7), T ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (7) T ACC         2500      NOISE

40   22 JUN 73, 0129, MELENDY RIDGE (7), T ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (7) T ACC         2500      SIGNAL

41   22 JUN 73, 0129, MELENDY RIDGE (7), Z ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (7) Z ACC         2500      NOISE

42   22 JUN 73, 0129, MELENDY RIDGE (7), Z ACC
        1    0  -0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (7) Z ACC         2500      SIGNAL

43   22 JUN 73, 0129, CROSS (8), R ACC
        1    0   0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (8) R ACC         2500      NOISE

44   22 JUN 73, 0129, CROSS (8), R ACC
        1    0   0.03716      0.0200      0.7070    0.0000    0.0100    1.0000    0.0000
     4 0.02000 4 0.02000 4  100.00
     2  .00400 (8) R ACC         2500      SIGNAL
```

```
45    22 JUN 73, 0129, CROSS (8), T ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.02000 4 0.02000 4    100.00
      2  .00400 (8) T ACC        2500       NOISE

46    22 JUN 73, 0129, CROSS (8), T ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.02000 4 0.02000 4    100.00
      2  .00400 (8) T ACC        2500       SIGNAL

47    22 JUN 73, 0129, CROSS (8), Z ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.02000 4 0.02000 4    100.00
      2  .00400 (8) Z ACC        2500       NOISE

48    22 JUN 73, 0129, CROSS (8), Z ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.02000 4 0.02000 4    100.00
      2  .00400 (8) Z ACC        2500       SIGNAL

49    7 FEB 74, 1035, MELENDY WINDMILL (2), R ACC
         1    0    0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000-2     29.50
      2  .00500 (2) R ACC        2500       NOISE

50    7 FEB 74, 1035, MELENDY WINDMILL (2), R ACC
         1    0    0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000-2     29.50
      2  .00500 (2) R ACC        2500       SIGNAL

51    7 FEB 74, 1035, MELENDY WINDMILL (2), T ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000-2     29.50
      2  .00500 (2) T ACC        2500       NOISE

52    7 FEB 74, 1035, MELENDY WINDMILL (2), T ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000-2     29.50
      2  .00500 (2) T ACC        2500       SIGNAL

53    7 FEB 74, 1035, MELENDY WINDMILL (2), Z ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000-2     29.50
      2  .00500 (2) Z ACC        2500       NOISE

54    7 FEB 74, 1035, MELENDY WINDMILL (2), Z ACC
         1    0   -0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000-2     29.50
      2  .00500 (2) Z ACC        2500       SIGNAL

55    7 FEB 74, 1035, JUNGLE INN (4), R ACC
         1    0    0.03716      0.0200      0.7070      0.0000      0.0100      1.0000      0.0000
      4 0.04000 4 0.02000 2     29.50
      2  .00400 (4) R ACC        2500       NOISE
```

```
56    7 FEB 74, 1035, JUNGLE INN (4), R ACC
         1    0    0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.04000 4 0.02000 2     29.50
      2  .00400 (4) R ACC        2500      SIGNAL

57    7 FEB 74, 1035, JUNGLE INN (4), T ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.04000 4 0.02000 2     29.50
      2  .00400 (4) T ACC        2500      NOISE

58    7 FEB 74, 1035, JUNGLE INN (4), T ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.04000 4 0.02000 2     29.50
      2  .00400 (4) T ACC        2500      SIGNAL

59    7 FEB 74, 1035, JUNGLE INN (4), Z ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.04000 4 0.02000 2     29.50
      2  .00400 (4) Z ACC        2500      NOISE

60    7 FEB 74, 1035, JUNGLE INN (4), Z ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.04000 4 0.02000 2     29.50
      2  .00400 (4) Z ACC        2500      SIGNAL

61    7 FEB 74, 1035, CROSS (8), R ACC
         1    0    0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.03333 4 0.02000 2     10.00
      2  .00400 (8) R ACC        2500      NOISE

62    7 FEB 74, 1035, CROSS (8), R ACC
         1    0    0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.03333 4 0.02000 2     10.00
      2  .00400 (8) R ACC        2500      SIGNAL

63    7 FEB 74, 1035, CROSS (8), T ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.03333 4 0.02000 2     10.00
      2  .00400 (8) T ACC        2500      NOISE

64    7 FEB 74, 1035, CROSS (8), T ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.03333 4 0.02000 2     10.00
      2  .00400 (8) T ACC        2500      SIGNAL

65    7 FEB 74, 1035, CROSS (8), Z ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.03333 4 0.02000 2     10.00
      2  .00400 (8) Z ACC        2500      NOISE

66    7 FEB 74, 1035, CROSS (8), Z ACC
         1    0   -0.03716     0.0200     0.7070    0.0000    0.0100    1.0000    0.0000
      4 0.03333 4 0.02000 2     10.00
      2  .00400 (8) Z ACC        2500      SIGNAL
```

```
67   6 JULY 74, MELENDY WINDMILL (2), R ACC
        1    0    0.01449     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02500 4 0.02500
      2  .00500 (2) R ACC        2500      NOISE

68   6 JULY 74, MELENDY WINDMILL (2), R ACC
        1    0    0.01449     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02500 4 0.02500
      2  .00500 (2) R ACC        2500      SIGNAL

69   6 JULY 74, MELENDY WINDMILL (2), T ACC
        1    0   -0.01635     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02500 4 0.02500
      2  .00500 (2) T ACC        2500      NOISE

70   6 JULY 74, MELENDY WINDMILL (2), T ACC
        1    0   -0.01635     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02500 4 0.02500
      2  .00500 (2) T ACC        2500      SIGNAL

71   6 JULY 74, MELENDY WINDMILL (2), Z ACC
        1    0   -0.00743     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02500 4 0.02500
      2  .00500 (2) Z ACC        2500      NOISE

72   6 JULY 74, MELENDY WINDMILL (2), Z ACC
        1    0   -0.00743     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
      4 0.02500 4 0.02500
      2  .00500 (2) Z ACC        2500      SIGNAL

73   6 JULY 74, MELENDY WINDMILL (2), R DISP (SHORT)
        1    0    405101.4    29.500     0.7070     0.0000     0.0100     1.0000     0.0000
      1  29.500 4 0.02500 2  0.0200 1    29.50    100.00
      2  .00500 (2) R DIS        2500      NOISE

74   6 JULY 74, MELENDY WINDMILL (2), R DISP (SHORT)
        1    0    405101.4    29.500     0.7070     0.0000     0.0100     1.0000     0.0000
      1  29.500 4 0.02500 2  0.0200 1    29.50    100.00
      2  .00500 (2) R DIS        2500      SIGNAL

75   6 JULY 74, MELENDY WINDMILL (2), T DISP (SHORT)
        1    0    405101.4    29.500     0.7070     0.0000     0.0100     1.0000     0.0000
      1  29.500 4 0.02500 2  0.0200 1    29.50    100.00
      2  .00500 (2) T DIS        2500      NOISE

76   6 JULY 74, MELENDY WINDMILL (2), T DISP (SHORT)
        1    0    405101.4    29.500     0.7070     0.0000     0.0100     1.0000     0.0000
      1  29.500 4 0.02500 2  0.0200 1    29.50    100.00
      2  .00500 (2) T DIS        2500      SIGNAL

77   6 JULY 74, MELENDY WINDMILL (2), Z DISP (SHORT)
        1    0    405101.4    29.500     0.7070     0.0000     0.0100     1.0000     0.0000
      1  29.500 4 0.02500 2  0.0200 1    29.50    100.00
      2  .00500 (2) Z DIS        2500      NOISE
```

```
78      6 JULY 74, MELENDY WINDMILL (2), Z DISP (SHORT)
            1    0   405101.4       29.500      0.7070     0.0000      0.0100      1.0000      0.0000
         1  29.500 4 0.02500 2   0.0200 1     29.50      100.00
         2   .00500 (2) Z DIS          2500     SIGNAL

79      6 JULY 74, HILLTOP(3), R ACC
            1    0     0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (3) R ACC          2500      NOISE

80      6 JULY 74, HILLTOP(3), R ACC
            1    0     0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (3) R ACC          2500     SIGNAL

81      6 JULY 74, HILLTOP(3), T ACC
            1    0    -0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (3) T ACC          2500      NOISE

82      6 JULY 74, HILLTOP(3), T ACC
            1    0    -0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (3) T ACC          2500     SIGNAL

83      6 JULY 74, HILLTOP(3), Z ACC
            1    0    -0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (3) Z ACC          2500      NOISE

84      6 JULY 74, HILLTOP(3), Z ACC
            1    0    -0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (3) Z ACC          2500     SIGNAL

85      6 JULY 74, JUNGLE INN(4), R ACC
            1    0     0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (4) R ACC          2500      NOISE

86      6 JULY 74, JUNGLE INN(4), R ACC
            1    0     0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (4) R ACC          2500     SIGNAL

87      6 JULY 74, JUNGLE INN(4), T ACC
            1    0    -0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (4) T ACC          2500      NOISE

88      6 JULY 74, JUNGLE INN(4), T ACC
            1    0    -0.03716      0.0200      0.7070     0.0000      0.0100      1.0000      0.0000
         4 0.02500 4 0.02500
         2   .00400 (4) T ACC          2500     SIGNAL
```

```
89     6 JULY 74, JUNGLE INN(4), Z ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (4) Z ACC       2500      NOISE

90     6 JULY 74, JUNGLE INN(4), Z ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (4) Z ACC       2500      SIGNAL

91     6 JULY 74, BICKMORE(6), R ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (6) R ACC       2500      NOISE

92     6 JULY 74, BICKMORE(6), R ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (6) R ACC       2500      SIGNAL

93     6 JULY 74, BICKMORE(6), T ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (6) T ACC       2500      NOISE

94     6 JULY 74, BICKMORE(6), T ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (6) T ACC       2500      SIGNAL

95     6 JULY 74, BICKMORE(6), Z ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (6) Z ACC       2500      NOISE

96     6 JULY 74, BICKMORE(6), Z ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00400 (6) Z ACC       2500      SIGNAL

97     6 JULY 74, MELENDY RIDGE(7), R ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00500 (2) R ACC       2500      NOISE

98     6 JULY 74, MELENDY RIDGE(7), R ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00500 (2) R ACC       2500      SIGNAL

99     6 JULY 74, MELENDY RIDGE(7), T ACC
           1   0   -0.03716    0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
        4 0.02500 4 0.02500
        2  .00500 (2) T ACC       2500      NOISE
```

```
100     6 JULY 74, MELENDY RIDGE(7), T ACC
            1    0   -0.03716     0.0200    0.7070    0.0000    0.0100    1.0000    0.0000
         4 0.02500 4 0.02500
         2  .00500 (2) T ACC          2500    SIGNAL

101     6 JULY 74, MELENDY RIDGE(7), Z ACC
            1    0   -0.03716     0.0200    0.7070    0.0000    0.0100    1.0000    0.0000
         4 0.02500 4 0.02500
         2  .00500 (2) Z ACC          2500     NOISE

102     6 JULY 74, MELENDY RIDGE(7), Z ACC
            1    0   -0.03716     0.0200    0.7070    0.0000    0.0100    1.0000    0.0000
         4 0.02500 4 0.02500
         2  .00500 (2) Z ACC          2500    SIGNAL

103     6 JULY 74, MELENDY RIDGE(7), R DISP
            1    0   405101.4     29.500    0.7070    0.0000    0.0100    1.0000    0.0000
         1  29.500 4 0.25000 2  0.0200 1   29.50    100.00
         2  .02500 (7) R DIS          2500     NOISE

104     6 JULY 74, MELENDY RIDGE(7), R DISP
            1    0   405101.4     29.500    0.7070    0.0000    0.0100    1.0000    0.0000
         1  29.500 4 0.25000 2  0.0200 1   29.50    100.00
         2  .02500 (7) R DIS          2500    SIGNAL

105     6 JULY 74, MELENDY RIDGE(7), T DISP
            1    0   405101.4     29.500    0.7070    0.0000    0.0100    1.0000    0.0000
         1  29.500 4 0.25000 2  0.0200 1   29.50    100.00
         2  .02500 (7) T DIS          2500     NOISE

106     6 JULY 74, MELENDY RIDGE(7), T DISP
            1    0   405101.4     29.500    0.7070    0.0000    0.0100    1.0000    0.0000
         1  29.500 4 0.25000 2  0.0200 1   29.50    100.00
         2  .02500 (7) T DIS          2500    SIGNAL

107     6 JULY 74, MELENDY RIDGE(7), Z DISP
            1    0   405101.4     29.500    0.7070    0.0000    0.0100    1.0000    0.0000
         1  29.500 4 0.25000 2  0.0200 1   29.50    100.00
         2  .02500 (7) Z DIS          2500     NOISE

108     6 JULY 74, MELENDY RIDGE(7), Z DISP
            1    0   405101.4     29.500    0.7070    0.0000    0.0100    1.0000    0.0000
         1  29.500 4 0.25000 2  0.0200 1   29.50    100.00
         2  .02500 (7) Z DIS          2500    SIGNAL

109     6 JULY 74, MELENDY CROSS(8), R ACC
            1    0    0.03716     0.0200    0.7070    0.0000    0.0100    1.0000    0.0000
         4 0.02500 4 0.02500
         2  .00400 (8) R ACC          2500     NOISE

110     6 JULY 74, MELENDY CROSS(8), R ACC
            1    0    0.03716     0.0200    0.7070    0.0000    0.0100    1.0000    0.0000
         4 0.02500 4 0.02500
         2  .00400 (8) R ACC          2500    SIGNAL
```

```
111    6 JULY 74, MELENDY CROSS(8), T ACC
           1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
         4 0.02500 4 0.02500
         2  .00400 (8) T ACC        2500      NOISE

112    6 JULY 74, MELENDY CROSS(8), T ACC
           1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
         4 0.02500 4 0.02500
         2  .00400 (8) T ACC        2500     SIGNAL

113    6 JULY 74, MELENDY CROSS(8), Z ACC
           1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
         4 0.02500 4 0.02500
         2  .00400 (8) Z ACC        2500      NOISE

114    6 JULY 74, MELENDY CROSS(8), Z ACC
           1    0   -0.03716     0.0200     0.7070     0.0000     0.0100     1.0000     0.0000
         4 0.02500 4 0.02500
         2  .00400 (8) Z ACC        2500     SIGNAL

115    6 JULY 74, MELENDY CROSS(8), R DIS
           1    0   405101.4     29.500     0.7070     0.0000     0.0100     1.0000     0.0000
         1  29.500 4 0.12500 2   0.0200 1    29.50     100.00
         2  .02000 (8) R DIS        2500      NOISE

116    6 JULY 74, MELENDY CROSS(8), R DIS
           1    0   405101.4     29.500     0.7070     0.0000     0.0100     1.0000     0.0000
         1  29.500 4 0.12500 2   0.0200 1    29.50     100.00
         2  .02000 (8) R DIS        2500     SIGNAL

117    6 JULY 74, MELENDY CROSS(8), T DIS
           1    0   405101.4     29.500     0.7070     0.0000     0.0100     1.0000     0.0000
         1  29.500 4 0.12500 2   0.0200 1    29.50     100.00
         2  .02000 (8) T DIS        2500      NOISE

118    6 JULY 74, MELENDY CROSS(8), T DIS
           1    0   405101.4     29.500     0.7070     0.0000     0.0100     1.0000     0.0000
         1  29.500 4 0.12500 2   0.0200 1    29.50     100.00
         2  .02000 (8) T DIS        2500     SIGNAL

119    6 JULY 74, MELENDY CROSS(8), Z DIS
           1    0   405101.4     29.500     0.7070     0.0000     0.0100     1.0000     0.0000
         1  29.500 4 0.12500 2   0.0200 1    29.50     100.00
         2  .02000 (8) Z DIS        2500      NOISE

120    6 JULY 74, MELENDY CROSS(8), Z DIS
           1    0   405101.4     29.500     0.7070     0.0000     0.0100     1.0000     0.0000
         1  29.500 4 0.12500 2   0.0200 1    29.50     100.00
         2  .02000 (8) Z DIS        2500     SIGNAL
```

Table 5. Computer program for reading the near-field digital tape.


```
      PROGRAM READDF (INPUT,OUTPUT,TAPE5)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C          THE PROGRAM READDF READS ONE DATA FILE OF DIGITIZED SEISMIC
C     DATA FROM A DIGITAL MAGNETIC TAPE.  THE INFORMATION IS STORED IN
C     A CARD-IMAGE BCD FORMAT ON TAPE.  THE TAPE IS REFERENCED AS TAPE5.
C
C          THE INPUT CONSISTS OF ONE CARD INDICATING THE NUMBER OF THE
C     DATA FILE WHICH IS TO BE READ.  THE OUTPUT CONSISTS OF A PRINTOUT
C     OF THE FOUR INFORMATION CARDS STORED AT THE BEGINNING OF THE DATA
C     BLOCK, A PRINTOUT OF THE START AND STOP TIME OF THE DATA BLOCK,
C     AND THE DATA WHICH ARE STORED AS NPR FLOATING POINT NUMBERS IN
C     THE ARRAY DATA.
C          THE INFORMATION CARDS CONTAIN THE INSTRUMENT CONSTANTS AND
C     AND FILTER SETTINGS WHICH WERE USED IN RECORDING AND DIGITIZING
C     THE DATA.
C
C
C
C     INPUT  --
C          NF        (I5)
C                    NF     NUMBER OF DATA FILE ON TAPE WHICH IS TO BE READ
C
C     OUTPUT  --
C          ID        (8A10)
C                    ID     IDENTIFICATION
C          IIR,NIN,AIN,ST,SH,SL,GT,GH,CSG       (2I5,7F10.4)
C                    IIR    INCLUDE INSTRUMENT RESPONSE IF IIR .GT. 0
C                    NIN    TYPE OF TRANSDUCER ON INSTRUMENT
C                               NIN = 0  DISPLACEMENT
C                               NIN = 1  VELOCITY
C                               NIN = 2  ACCELERATION
C                    AIN    MAGNIFICATION AT 1 HZ
C                    ST     PERIOD OF PENDULUM
C                    SH     DAMPING OF PENDULUM  (1.  FOR CRITICAL)
C                    SL     INDUCTANCE OVER CIRCUIT RESISTANCE
C                    GT     PERIOD OF GALVONOMETER
C                    GH     DAMPING OF GALVONOMETER
C                    CSG    COUPLING
C          NS1,PF1,NS2,PF2,NS3,PF3,NS4,PF4,GN4        (4(I2,F8.2),F10.4)
C                    NS1    ORDER NUMBER OF 1ST FILTER (NEG FOR HIGH-PASS)
C                    PF1    CORNER PERIOD OF 1ST FILTER
C                    NS2    ORDER NUMBER OF 2ND FILTER (NEG FOR HIGH-PASS)
C                    PF2    CORNER PERIOD OF 2ND FILTER
C                    NS3    ORDER NUMBER OF 3RD FILTER (NEG FOR HIGH-PASS)
C                    PF3    CORNER PERIOD OF 3RD FILTER
C                    NS4    ORDER NUMBER OF UNITY GAIN FILTER
C                    PF4    CORNER PERIOD OF UNITY GAIN FILTER
C                    GN4    GAIN OF UNITY GAIN FILTER
C          NHT,SAMP,STAT,NPR,SNFL      (I2,F8.5,A1 ,I10,A10)
C                    NHT    FLAG INDICATING WHETHER DATA HAS HEADER-TAILER
C                    SAMP   SAMPLE INTERVAL (SEC)
C                    STAT   IDENTIFICATION GIVING THE COMPONENT
C                    NPR    NUMBER OF DATA POINTS IN THE DATA BLOCK
C                    SNFL   IDENTIFICATION AS EITHER SIGNAL OR NOISE SAMPLE
C           THREE LINES OF PRINT GIVING THE START AND STOP TIME OF DATA
C
```

```
C
C     TRANSFER VECTOR  --  TIME
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
      DIMENSION NH(12),N(5000),NT(12),ID(8),IN1(8),IN2(8),DATA(5000)
      EQUIVALENCE (N(1),DATA(1))
      M=0
      READ 110,NF
110   FORMAT(I5)
      IF (NF .LE. 0)  GO TO 1
100   READ(5,10)ID
101   M=M+1
102   READ(5,10) ID
      IF(EOF,5)103,102
103   IF (M-NF) 100,1,1
1     READ(5,10)ID
      M=M+1
10    FORMAT(8A10)
      READ(5,10)IN1
      READ(5,10)IN2
      READ(5,11)NHT,SAMP,STAT,NPR,SNFL
11    FORMAT(I2,F8.5,A10,I10,A10)
      READ(5,20)(NH(I),I=1,12),(N(I),I=1,17)
20    FORMAT(12O1,17O4)
      IF(NPR .LE.2500) GO TO 31
32    DO 34 I=1,249
      K=18+(I-1)*20
      L=17+I*20
      READ(5,40)(N(J),J=K,L)
40    FORMAT(20O4)
34    CONTINUE
      READ(5,44)(N(I),I=4998,5000),(NT(I),I=1,12)
44    FORMAT(3O4,12O1)
      GO TO 52
31    DO 35 I=1,124
      K=18+(I-1)*20
      L=17+I*20
      READ(5,40)(N(J),J=K,L)
35    CONTINUE
      READ(5,45)(N(I),I=2498,2500),(NT(I),I=1,12)
45    FORMAT(3O4,12O1)
52    CALL TIME(NH,NDAYS,NHOURS,MIN,NSEC)
      PRINT 55,M,ID
55    FORMAT(1H0,I5,5X8A10)
      PRINT 56,IN1
56    FORMAT(1H ,10X8A10)
      PRINT 56,IN2
      PRINT 57,NHT,SAMP,STAT,NPR,SNFL
57    FORMAT(1H ,10XI2,F8.5,A10,I10,A10)
      PRINT 6,STAT,NDAYS,NHOURS,MIN,NSEC
6     FORMAT(1H0,* DIGITISATION STARTING FROM TIME FOR *,A10,* IS *,I3,*
     1 DAYS, *,I2,* HOURS, *,I2,* MINUTES, *,I2,* SECONDS,*,/,* NOTE THA
     2T DATA WILL START 3 SAMPLES LATER DUE TO THE WRITING OF THE HEADER
     3.*)
      CALL TIME(NT,NDAYS,NHOURS,MIN,NSEC)
      PRINT 7,NDAYS,NHOURS,MIN,NSEC
```

```
7       FORMAT(* STOP TIME*,I4,* DAYS, *,I2,* HOURS, *,I2,* MINUTES, *,I2,
       1* SECONDS,*,///)
        DO 120 J=1,NPR
        IF (N(J) .GE. 2048)  N(J) = N(J)-4096
        DATA(J) = N(J)
120     CONTINUE
        STOP
        END



        SUBROUTINE TIME (L,NDAYS,NHOURS,MIN,NSEC)
        DIMENSION L(12)
        NDAYS=(L(1).AND.1)*200+(L(2).AND.4)*25+(L(2).AND.3)*40+(L(3).AND.6
       1)*5+(L(3).AND.1)*8+(L(4).AND.7)
        NHOURS=(L(5).AND.1)*20+((L(6).AND.4)/4)*10+(L(6).AND.3)*4+(L(7).AN
       1D.6)/2
        MIN=(L(8).AND.7)*10+(L(9).AND.7)*2+(L(10).AND.4)/4
        NSEC=(L(10).AND.1)*40+(L(11).AND.6)*5+(L(11).AND.1)*8+(L(12).AND.7
       1)
        RETURN
        END
```

IX Papers

The following papers report work which was completed in the past two and one half years with support from this grant.

Johnson, L. R., Green's function for Lamb's problem, Geophys. J. R. Astr. Soc., 37, 99-131, 1974.

Johnson, L. R., A. Mazzella, T. V. McEvilly, H. F. Morrison, A search for premonitory changes in seismic velocities and deep resistivity associated with central California earthquakes, paper presented at Symposium on Earthquake Forerunners Searching, Tashkent, USSR, 27 May - 3 June, 1974.

Johnson, L. R., T. V. McEvilly, Near-field observations and source parameters of Central California earthquakes, Bull. Seism. Soc. Am., 64, 1855-1886, 1974.

Kurita, T., Attenuation of shear waves along the San Andreas fault zone in central California, Bull. Seism. Soc. Am., 65, 277-292, 1975.

Litehiser, J., Near-field accelerations from a propagating dislocation, paper presented at the Fall Annual Meeting of the American Geophysical Union, San Francisco, December 4-7, 1972.

Litehiser, J., Near-field accelerations from a propagating dislocation, San Fernando earthquake, paper presented at the Annual Meeting of the American Geophysical Union, Washington, D.C., April 8-12, 1974.

McNally, K., The process of earthquake occurrence on an active fault segment, paper presented at the Annual Meeting of the Seismological Society of America, Las Vegas, March 29-31, 1974.

McNally, K., T. V. McEvilly, Faulting details from first motion studies in central California, paper presented at Fall Annual Meeting of the American Geophysical Union, San Francisco, December 12-17, 1974.

Peppin, W., G. Simila, D. Gehant, T. V. McEvilly, Detailed seismicity of the Cape Mendocino area, paper presented at Fall Annual Meeting of the American Geophysical Union, San Francisco, December 4-7, 1972.

Savage, W. U., K. McNally, Moderate earthquake seismicity in central California, 1936-1973, paper presented at Annual Meeting of the Seismological Society of America, Las Vegas, March 29-31, 1974.

Simila, G. W., Dilatancy and sea level changes, paper presented at Fall Annual Meeting of the American Geophysical Union, San Francisco, December 12-17, 1974.

Simla, G., W. Peppin, T. V. McEvilly, Seismotectonics of the Cape Mendocino area, Bull. Geol. Soc. Am., in press, 1975.

Stump, B., P and S corner frequencies observed in the near field and the effect of attenuation, paper presented at Fall Annual Meeting of the American Geophysical Union, San Francisco, December 12-17, 1974.